Workflow Disruption and Solutions: Forces Against Focus in the OR

Abstract: This white paper explores how delays, interruptions, and distractions (DIDs) can impact the workflow in operating rooms (ORs). Research studies show that DIDs are associated with longer surgeries, increased stress for the medical team, and worse outcomes for patients. Key conceptualizations of workflow disruption include: DIDs related or unrelated to patient care, and DIDs due primarily to human activity or technological constraints. Various human-centric solutions have been offered by a host of governing and regulatory agencies. This analysis emphasizes the need for better design in surgical devices to reduce noise and other distractions, as well as improve freedom of movement, surgical workflow, and patient outcomes.

Keywords: Arthroscopy; endoscopy; operating room; workflow disruptions; delays, distractions, interruptions; surgical outcomes; surgical visualization.

The Problem: Choppy Workflow in the OR

In the operating room (OR), minor workflow disruptions can have significant consequences. A growing body of research shows that delays, interruptions, and distractions (DIDs) correlate with extended operating times, increased mental workload, more stress, poor performance, and negative patient outcomes.[1] Nearly all of the research studies conclude DIDs are a widespread problem. We're most interested in minimally invasive surgery (MIS), for which researchers have found OR workflow interrupted at various rates. In separate studies, abdominal and orthopedic surgeries were interrupted 10 times per hour,[3] while laparoscopic cholecystectomies were subject to 95 "microcomplications" per hour.[2]

This white paper surveys some of the leading articles on DIDs, considers the impact of DIDs on workflow and surgical outcomes, and highlights potential solutions to mitigate their effects.

Key Concepts

A variety of concepts have been employed to describe workflow disruption in the OR. For clarity's sake, we recommend the use of delay, distraction, and interruption. A **delay** pertains to events that affect the timely start of the surgery–e.g., an OR setup error or staff tardiness. It also pertains to objective failures of devices or components, either before or during the procedure. Traffic in and out of the OR can serve as a **distraction** to some members of the team, but surgical workflow may continue without pause. Any pause in that workflow would then pair this distraction to an **interruption**.

Various Forms of Delays, Distractions, and Interruptions

Here, we offer a simple table of the top two levels of a DID taxonomy. First, there are intrinsic (related to patient care) and extrinsic (unrelated to patient care) DIDs. Second, DIDs are the result of either human activity (H, in the table below), the features and constraints of technologies (T), or some combination of the two.

Table 1: DID Taxonomy: An Introduction

Top DIDs	Intrinsic	Extrinsic
Noise	Case-relevant communication (H) Device hum (T)	Case-irrelevant communication (H) Select alarms on medical devices (T)
OR traffic	Entry/exit of participating staff (H)	Entry/exit of non-participating staff (H)
Surgical process	Equipment failures (T)	Transition of physician's assistants (H)

Categories such as equipment failures are subject to further elaboration. In one study, equipment-related complications included:

- Devices or components that were missing or nonfunctioning.
- Set-up ergonomics (e.g., misplaced foot pedals).
- Procedural problems (e.g., task-based complications such as tangled cables).[2]

Such complications have differential impact on OR staff. In terms of focus, one study found that interruptions were more pronounced for surgeons and their assistants than for nurses and anesthesiologists.[4] Some interruptions can, in fact, provide useful information or relieve stress. Still, researchers confirm that higher rates of DID are associated with increased stress for the staff, incomplete safety checks, surgical errors, procedure duration, and adverse health effects for patients and staff.[1]

Optimal Working Conditions in the OR

"When I'm scrubbed in, the patient is draped and you give me—the instant you put that scope in my hand," says Nicholas Colyvas MD, FAAOS (orthopedics, University of California, San Francisco), "this sort of calming feeling comes along. 'Okay: I'm in control. This piece of equipment that I have in my hands is an extension of me.'"[5] Dr. Colyvas's description closely mirrors Mihaly Csíkszentmihályi's vision of "flow," as he's completely immersed in the task: his "whole being is involved," using "[his] skills to the utmost."[6]

The hand-to-camera extension depends upon the eyes-to-monitor extension–and the duration of that extension. In the initial phase of minimally invasive surgery, that duration may be limited, as the surgeon switches the camera from portal to portal. The category of "gaze disruption"–the diverting of the surgeon's gaze from the surgical

monitor–includes instrument exchange, which is largely predictable and may be incorporated into the flow of the procedure. Unanticipated interruptions, though (e.g., equipment troubleshooting), disrupt task performance and correlate with surgical errors. Under ideal conditions, the surgeon can keep their gaze fixed on the surgical monitor with limited interruptions. However, in the minimally invasive OR, the ideal is exceptional: one time-motion study of "lap choles" found an average of 23 equipment troubleshooting incidents per procedure.[7]

How to Preserve OR Workflow and Boost Gaze Duration

Several solutions have been proposed to mitigate the effects of DIDs in the OR. These include more diligent use of tools such as the Disruptions in Surgery Index and the Surgical Safety Checklist. In 2016, the American College of Surgeons (ACS) weighed in with a list of recommendations regarding DIDs extrinsic to patient care:

- Cell phone use (limit it).
- Music choice (keep it mellow).
- OR foot traffic (reduce it).

They also made a single recommendation on the design of next-generation devices for the OR: "Reduced surgical equipment noise should be conveyed as a critical design factor to surgical instrument and device manufacturers."[8] Concern over this particular design factor was especially timely. In 2016, the Joint Commission (JC) estimated that per-patient alarms in the hospital exceeded 100 daily, and that over 85% of those alarms required no clinical intervention.[9] (**Note on OR traffic:** a 2023 study found that "room time" was significantly longer for two procedures, hip replacements and knee arthroplasties, for each additional circulating nurse listed on OR personnel rosters.)[10]

The JC's recommendation offers a necessary reminder that the OR is a sonic, visual, and corporeal domain. With the advent of 4K technology in surgical visualization, pixels and colors became the dominant metrics in OR innovation. 4K monitors and cameras are, without question, magnificent additions to the OR. Even so, the research suggests that no degree of visual perfection can overcome the problems associated with gaze disruption. The efficacy of surgical visualization devices is limited, for example, by what's happening at the surgical site itself—a domain often overlooked in DID research. With the invention of the Operating Room Black Box, by Surgical Safety Technologies, Inc., researchers have a powerful new tool for producing detailed technical data on surgical procedures.[11] To date, these studies have focused primarily on intrinsic, human DIDs in the OR. We expect the next wave of research to focus on how intrinsic, tech-based DIDs contribute to—or impede—workflow cadence in the OR, with a renewed focus on gaze disruption and duration.

The Joint Commission continues to offer smart, episodic advisories on equipment problems and patient outcomes. In spring 2023, the commission issued Quick Safety Advisory 69 on burns and fires in the OR associated with the light cables of conventional surgical cameras.[12] In its recommendations, though, the JC stopped short of inviting surgical device manufacturers to imagine design factors that might eliminate fire hazards in the OR. Still, a more sustained focus on device-related DIDs in the sterile field looks promising. As noted above, with researchers finding surgical teams performing up to 23 troubleshooting tasks per procedure, it's clear that the efficacy and DID-prone nature of devices within the sterile field are due for examination. We look forward to future studies of delays, distractions, and interruptions that focus on how OR technologies foster—or constrain—the freedom and focus of OR staff and, in turn, affect patient outcomes.

References

1. McMullan R, Urwin R, Gates P, et al. Are operating room distractions, interruptions, and disruptions associated with performance and patient safety? A systematic review and meta-analysis. *International Journal for Quality in Health Care*. 2021;33(2): 1-10. https://doi.org/10.1093/Intqhc/Mzab068.
2. Antoniadis S, Passauer-Baierl S, Baschnegger, H, et al. Identification and interference of intraoperative distractions and interruptions in operating rooms. *Journal of Surgical Research*. 2014;188(1): 21-29. https://doi.org/10.1016/j.jss.2013.12.002.
3. von Strauss Und Torney M, Aghlmandi S, Zeindler J, et al. High-resolution standardization reduces delay due to workflow disruptions in laparoscopic cholecystectomy. *Surgical Endoscopy*. 2018;32(12): 4763-4771. https://doi.org/10.1007/s00464-018-6224-y.
4. Er OS, Giersbergen M. The distraction perceptions of health care professionals in the operating room: The disruptions in surgery index (DiSI). *Journal of PeriAnesthesia Nursing*. 2023; in press. https://doi.org/10.1016/j.jopan.2023.07.010.
5. Sigman, S. "Dr. Nicholas Colyvas—Orthopedic surgeon, professor, mentor, and F1 race car driver." The Ortho Show. November 1, 2023. Podcast. https://theorthoshow.com/dr-nicholas-colyvas-orthopedic-surgeon-professor-mentor-and-f1-race-car-driver/.
6. Geirland, J. "Go with the flow." *Wired*. September 1996; 4(9).
7. Sutton E, Youssef Y, Meenaghanet N, et al. Gaze disruptions experienced by the laparoscopic operating surgeon. *Surgical Endoscopy*. 2010;24(6):1240-1244. https://doi.org/10.1007/s00464-009-0753-3.
8. American College of Surgeons. Statement on Distractions in the Operating Room. September 1, 2016. https://www.facs.org/about-acs/statements/distractions-in-the-operating-room/.
9. Mills, G. Joint Commission Update. ACCE. February 11, 2016. https://accenet.org/publications/Downloads/Presentations/JCT2016.pdf?Mobile=1.
10. Cousins H, Cahan E, Steere J, et al. Assessment of team dynamics and operative efficiency in hip and knee arthroplasty. *JAMA Surgery*. 2023;158(6):603–608. https://jamanetwork.com/journals/jamasurgery/article-abstract/2802864.
11. Hawn, M. "Why every operating room needs a black box." *AAMC News*. October 3, 2023. https://www.aamc.org/news/why-every-operating-room-needs-black-box.
12. Joint Commission. Preventing light source-related burns from laparoscopy, thoracoscopy and arthroscopy. Quick Safety. Issue 69: April 2023. http://tinyurl.com/quick-safety-69.

© 2024 Lazurite Inc. All rights reserved.
Lazurite and the Lazurite logo are registered trademarks of Lazurite.
24001D/20241.0